Tidal exchange of carbon, nitrogen and phosphorus between an Everglades mangrove forest and estuarine waters

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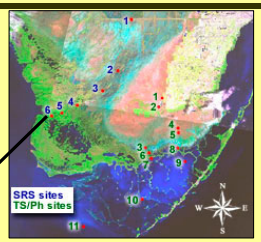
ABSTRACT

Carbon, nitrogen and phosphorus concentrations of water and organic matter flowing in and out of a tidal creek of the Florida Coastal Everglades LTER site SRS-6 have been measured. Data gathered during two trips in 2005 (before hurricanes Katrina and Wilma), one in dry season and one in wet season, are presented. Organic matter analyzed on carbon and nutrient content has shown a net export from the mangrove forest of carbon of 15.75 (+/- 4.48) grams per hour per m^2 creek diameter, and a net export of nitrogen of 0.54 (+/- 0.14) grams per hour per m^2 creek diameter during wet season. Both import and export of all nutrients was higher in wet season then in dry season, which might indicate a high influence of terrestrial runoff.

INTRODUCTION

Nutrient exchange between mangroves and near-shore waters is poorly understood given the difficulty of measuring nutrient fluxes in coastal wetlands. Although some studies in mangrove forests have shown a net export of detritus and negligible net exchange of nitrogen, much work is necessary before we can determine the role of mangroves in nutrient cycling in tropical estuaries. Knowledge of the nutrient exchange and transformation function of mangroves is valuable since exchange of materials and nutrients can be of ecological importance to the adjacent water, and it creates insight into what the consequences of changes in upland hydrology and nutrient loading are for coastal waters.

STUDY SITE



The mangrove site SRS 6 is part of the Long Term Ecological Research network located in the Everglades National Park, Florida.

OBJECTIVES

To determine:

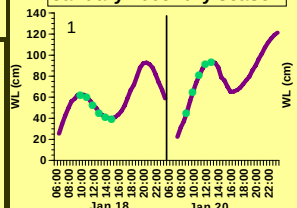
1) the role of the mangrove forest as sink or source of dissolved and suspended nitrogen, phosphorus and carbon.
2) the seasonality of nutrient fluxes.

APPROACH

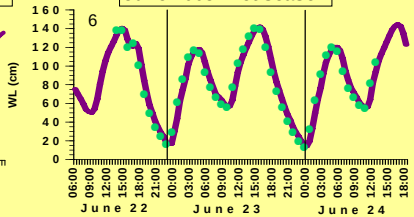
Water samples were taken with autosamplers at the mouth of two tidal creeks in January and June 2005. Samples were analyzed on inorganic nutrients NH_4, NO_3, NO_2, PO_4 with an auto analyzer and standard techniques, and on dissolved organic carbon using a carbon analyzer

Organic matter samples were taken with a small passive net with a mesh size of 363 µM at the mouth of two tidal creeks in January and June 2005. Samples were analyzed on total carbon and total nitrogen with a CHN-analyzer, and on total phosphorus using a dry digestion technique and an auto analyzer.

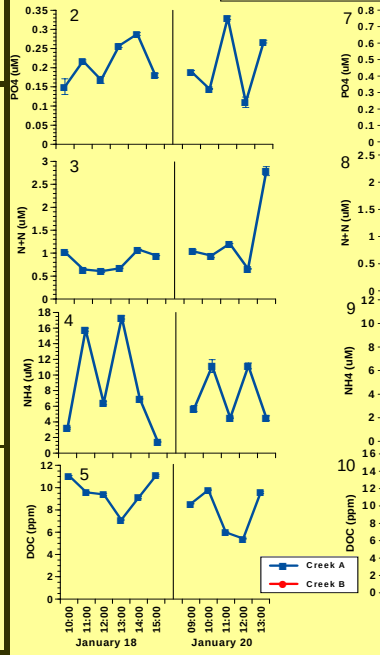
January 2005: dry season

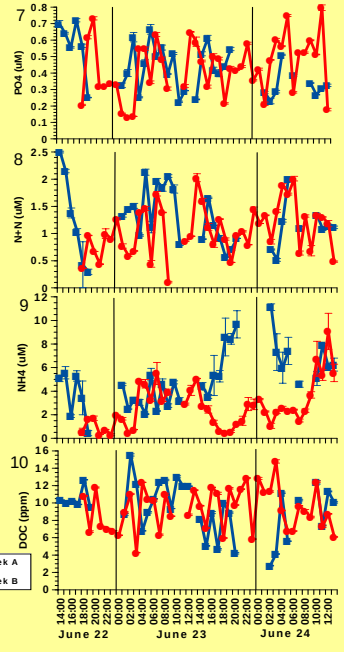


June 2005: wet season



Dissolved nutrients

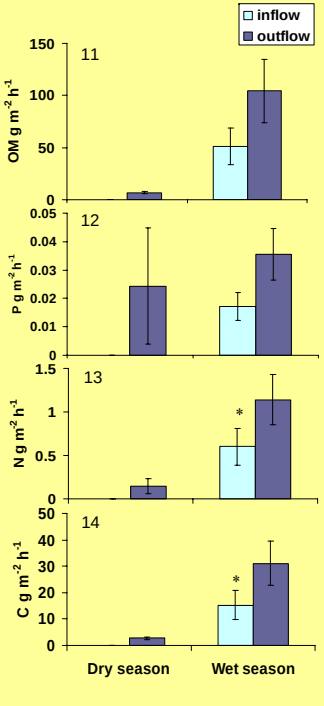




Suspended organic matter exchange

T1

Flux (g m^{-2} h^{-1})	Dry season	Wet season
OM	- 6.67	- 53.34
P	- 0.02	- 0.02
N	- 0.15	- 0.54 *
C	- 2.81	- 15.75 *



RESULTS

-Figures 1 and 6 show the water levels at the time of sampling, the green circles indicate the sampling moment for the water samples, and which half tides are sampled for suspended material with the small net.
- Figures 2 to 5 show concentrations of soluble reactive phosphorus, nitrate+nitrite, ammonium, and dissolved organic carbon respectively in January 2005. Concentration during outgoing tide (Jan 18) and incoming tide (Jan 20) can be compared.
- Figures 7 to 10 show concentrations of soluble reactive phosphorus, nitrate+nitrite, ammonium, and dissolved organic carbon respectively in June 2005. The concentrations can be related to the tidal activity shown in figure 6. Nitrate and nitrite concentrations show a decrease with outgoing tide and an increase with incoming tide, which could indicate an net import of nitrate and nitrite to the mangrove forest. Concentration changes in creek A and B show the same trends with a different timing which could indicate a delay in the smaller tidal creek.
- Figures 11 to 14 show exchange of suspended material and its nutrient content, resulting in fluxes listed in table 1. All fluxes show a net export, the export of nitrogen and carbon in the wet season is significant (T = 3.79, p = 0.0322 and T = 3.52, p = 0.039 respectively).

CONCLUSIONS

•Although the area of submerged mangrove forest is needed to calculate fluxes per m^2 mangrove forest with the concentrations of dissolved nutrients, relating concentration changes with water level changes provides a good indication of possible import or export of nutrients.

•Exchange of suspended material was much higher in wet season than in dry season. This resulted in much higher export fluxes of suspended material, nitrogen and carbon in wet season, but not in a higher flux of phosphorus. This indicates that upland run-off is an important source for nitrogen and carbon, but not for phosphorus. This also indicates that phosphorus is retained in the mangrove forest, since more material is exported in wet season, but the quality is lower.

•There is a net export of nitrogen and carbon as suspended material in the wet season, while the direction of the exchange of dissolved nutrients is inconclusive at this point

ACKNOWLEDGEMENT

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